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Measuring Effects of Trade Policy Distortions: How far have we come?

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ABSTRACT

Measuring Effects of Trade Policy Distortions: How far have we come?

Kym Anderson

After a brief review of the literature to the early 1970s, this paper assesses the contributions during the past three decades to measuring the distortionary effects of trade policies. It does not pretend to be comprehensive, but draws on selections from the literature that give a sense of the distance the profession has travelled from a trade policy practitioner's viewpoint since Corden's first paper on the subject in 1957. Phenomenal though that progress has been, there is ample room for further improvement in computing the economic (and other) effects of trade-related policies and their reform. The paper concludes with suggestions of where the priorities should be in global modelling of trade policy reform, as the world moves into the next round of multilateral trade negotiations.

Keywords: trade policy distortions, effective protection, cost of protection, empirical modelling of effects of trade policies

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This celebration of Max Corden's academic achievements provides an appropriate time to reflect on how far the international economics profession has progressed in measuring the extent and effects of trade policy distortions. Calculations of the extent of protection from import competition took a giant leap following the development and popularisation by Corden (plus Balassa and others) of the effective rate of protection concept in the 1960s. Subsequently, our abilities to empirically estimate the effects of protection on such things as production, consumption, trade, and national and global economic welfare and its distribution also have developed rapidly.

This paper begins with a brief review of the literature to the early 1970s (which is surveyed in detail in Corden 1975) and then focuses on contributions during the past three decades. It does not pretend to be comprehensive, especially since there is a lengthy survey available in Feenstra (1995). Rather, it simply draws on selections from that literature to give a sense of the distance the profession has travelled from a trade policy practitioner's viewpoint since Corden's first paper on the subject in 1957. Phenomenal though that progress has been, there is ample room for further improvement in our computational efforts. The paper concludes with suggestions of where the priorities should be in global modelling of trade policy reform, as the world moves into the next round of multilateral trade negotiations (the first since the conversion of the GATT Secretariat into the World Trade Organization following the completion of the Uruguay Round in 1994).

1. Measuring the extent of protection

Trade policy distortions can be due to taxes or subsidies on imports or exports, or quantitative restrictions on trade volumes (including trade bans) or values (as with WTO-condoned sanctions – see Anderson 2002b). Trade can be also distorted by interventions in foreign exchange markets, and of course by myriad domestic policy interventions such as output, input and factor taxes and subsidies. But over recent centuries perhaps the most common trade distortionary measure, and certainly the one most studied by international economists, is the import tax known commonly as the tariff.[1]

Aggregate tariff level indicators

To measure the extent of a country's aggregate tariff protection against import competition, attention focused initially on developing tariff level indexes. Early efforts include studies by Crawford (1934) and Carmody (1952) for Australia (infamous for having perhaps the highest manufacturing tariffs in the OECD in the twentieth century – see Anderson and Garnaut 1987), plus Loveday (1929), Liepmann (1938) and the League of Nations (1927) more generally. One of the problems with any aggregate measure, however, is that it cannot serve equally well all purposes simultaneously. Domestic uses for the index could be as an indication of the aggregate degree of resource re-allocation towards protected industries and/or of taxation of consumption of importables, or of foregone welfare gains from trade. International uses such as by trading partners could be as an indication of the degree of restriction

[1] In earlier centuries a common international trade barrier was state-condoned piracy on the high seas. See, for example, the popular history of the spice trade from 1553 to 1667 by Milton (1999), which gives a vivid account of the early days of intercontinental maritime commerce between Europe and Southeast Asia.

on import market access. These and other measurement issues associated with aggregate tariff level indicators are discussed in Michaely (1977).

Intra-sectoral resource re-allocation indicators: the effective rate of protection

In terms of indicators of resource re-allocation, substantial progress followed a paper on Canada's protection by Barber (1955), from which Corden (1963) developed and applied to Australia the concept of the effective rate of protection (ERP).[2] The distinction between nominal and effective protection is that the former measures the extent to which the tariff raises the domestic price of a producer's output whereas the latter indicates the extent to which the producer's value added is enhanced, taking into account any tariffs on importable intermediate inputs and the share of the industry's value added in the value of final output.

The ERP concept gained immediate recognition as a practical way of indicating more appropriately the level of industry protection against import competition not only in aggregate for a country but also – and more importantly -- between industries within a country. Its first official use was by the Australia Government with the publication of the Vernon Report (Vernon et al. 1965), to which Max Corden contributed; and the first major academic journal publication with cross-country estimates came out at the same time (Balassa 1965). The next few years saw an avalanche of both theoretical and empirical ERP papers and reports. In his first seminal book, Corden (1971) brings together most of the key theoretical ideas, while his survey of empirical studies (Corden 1975) covers the first decade of quantitative applications of the concept. The early empirical work includes numerous comparative studies of both industrial countries (Balassa et al. 1967) and developing countries (Little, Scitovsky and Scott 1970; Balassa et al. 1971), a testament to its widespread popularity. A striking feature of this literature is the genuine interaction between theory and empirical work, and between academic researchers and the policy community including the GATT (see, for example, the conference proceedings volume edited by Grubel and Johnson 1971).

These studies reveal many things (see Greenaway and Milner (2002) for more details), but four points in particular are worth mentioning here. First, the estimated EPRs far exceed nominal rates of protection (NRPs), suggesting that the resource pulls and hence costs of protection are much greater than the NRPs on their own might suggest. Second, the differences between NRPs and ERPs are not constant across countries, so that ERPs are to be preferred to NRPs for cross-country comparisons of the extent of protection. Third, while the NRP and ERP rankings of industries within countries are not greatly different when the degree of aggregation is fairly high, the rank correlation falls as the degree of disaggregation increases. This means ERPs are also better than NRPs for across-industry comparisons within a country, since the resource-pull cost of protection tends to increase with the range of ERPs, particularly within sub-sectors where substitution in production is high. And fourth, the ERPs expose a non-trivial number of industries where value added has been negative at international prices even though those activities were privately profitable because of the height of protection on the final product – clearly extreme cases of resource wastefulness.

[2] The history of the concept of protection on inputs affecting value added goes back more than a century. See Corden (1971, Appendix 1).

Since its first adoption officially in Australia, the EPR concept has been broadened to the effective rate of assistance (ERA) to industries, so as to capture in principle all forms of governmental assistance to producers.[3] This is helpful not only for those concerned with national resource allocation but also for trade negotiators, given the increasing tendency of negotiators to focus also on trade-related measures inside national borders as border protection falls.

Indicators of consumer price distortions

The ERP is of course not relevant as an indicator of the tariff's distortionary effect on consumption. Simple comparisons of the domestic wholesale price and the border price are more appropriate. The OECD has developed the latter further to calculate its so-called consumer subsidy equivalent (CSE) of agricultural policies (taking into account any direct government subsidies or taxes on consumers of the product concerned in addition to the tariff), to match its producer subsidy equivalent (PSE) measure.[4] While this is useful for simple comparisons between commodities, it has a similar weakness to the rate of producer protection concept in that the consumption, trade and economic welfare costs of that distortion due to the tariff depend not only on the price wedge but also on the own- and cross-price elasticities of demand, or the elasticities of substitution in consumption. And how any particular household's spending is affected depends also on the share of expenditure on each item in the household's consumption bundle.

Trade restrictiveness indicators

Useful though the ERP/ERA concept is, it does not give policy makers and trade negotiators very reliable indications of the trade and welfare effects of distortionary policies. Certainly partial and general equilibrium modelling can provide that, as discussed in the next section, but those models can require a great deal of information and analytical input that is often not readily available, particularly in developing countries. With that in mind, a single indicator of the trade-distorting and welfare-reducing effects of price and trade policies was developed in the 1990s for the World Bank, by Anderson and Neary (1994). Their trade restrictiveness index (TRI) requires somewhat more computation than just the NRP, but it provides a much more accurate indication of the effects on trade and welfare than can be guessed from NRP, ERP or PSE/CSE estimates.

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[3] ERAs have been published for all Australian manufacturing industries at the 2-, 3- and 4-digit levels of disaggregation each year since 1968-69, for all rural industries since 1970-71, and occasionally also for mining industries (whose ERAs are close to or below zero). Details can be freely downloaded from the website of Australia's Productivity Commission (formerly named the Tariff Board, the Industries Assistance Commission, and the Industry Commission), at www.pc.gov.au. The Commission also estimates and publishes the consumer tax equivalent of industry assistance policy measures including the tariff. The availability of such comprehensive estimates of ERAs has made it easier to use the economics of politics to explain the intra-sectoral pattern of assistance to industries. See, for example, Anderson (1978, 1980).

[4] The PSE attempts to take into account all forms of support to producers, not just the producer price-raising effect of a tariff on import-competing products. The OECD expresses its aggregate value as a percentage of total producer receipts for each commodity, and so it approaches only 100 per cent as the NRP approaches infinity (Anderson 1995a). Presumably the OECD members with the highest rates of protection to agriculture lobbied for the use of that denominator, rather than value at international prices which would not cap the PSE, so as to de-emphasise the inter-country differences in aggregate protection levels.

To see why the TRI is more informative, notice two difficulties with the NRP by considering first Figure 1(a), which shows a country's domestic demand and supply curves (D_i and S_i) for two goods (i = 1 or 2). Assume for simplicity of exposition (and without loss of generality) that the only forms of intervention in this small, otherwise open economy are import restrictions such as tariffs, which raise the domestic prices to O_iP_i', above the border prices of O_iP_i. The PSE in percentage terms in this case is $100(O_iP_i' - O_iP_i)/O_iP_i'$ and equals the negative of the CSE, and the NRP is $100(O_iP_i' - O_iP_i)/O_iP_i$. As drawn, these indicators are numerically smaller for good 1 than for good 2. Yet the trade effects of the tariffs as drawn are larger for good 1 than for good 2 ($a_1b_1 + c_1d_1 > a_2b_2 + d_2e_2$), so the NRP or PSE/CSE rankings would give the wrong impression of the ranking of trade effects of intervention as between these two goods.

The second difficulty has to do with obtaining an aggregate trade effect: what weights should be used to calculate the average NRP so as to indicate the size of the trade effect? Candidates include actual production, or consumption, or imports, each valued at border prices. Assuming for simplicity that both goods have a border price of $1 and tariff-distorted production of one unit, the production weights are equal and the weighted average NRP would be half way between the NRPs for the two goods. That is also the case in Figure 1(b), which is for another country that is identical to that shown in Figure 1(a) except that the larger tariff in this second country is applied to the market for the good with the more elastic import demand. Yet the trade effects are larger in Figure 1(b) than Figure 1(a). That is, if the production-weighted average NRP is used to infer trade effects for two countries that were identical except for which of the two goods had the higher tariff, they would be considered equally trade-distorting whereas the country represented in Figure 1(b) is more trade-distorting. If instead consumption or import weights were to be used, different average NRPs would in general be calculated. There is no obvious reason to prefer one over the other two, nor to prefer an average of them, for drawing trade inferences. Similar comments can be made if the net economic welfare effect rather than the trade effect was the item of interest.

Anderson and Neary (1994) follow Corden (1966) in their suggestion that a more satisfactory approach to measuring trade restrictiveness is to find the uniform tariff for the two goods that would be equivalent -- in the sense of yielding the same domestic welfare loss -- to the actual tariffs applied. The welfare loss is the sum of areas $a_ib_ic_i$ and $d_ie_if_i$ for each good in Figure 1(a) or 1(b). That is equivalent to area $a_ib_ic_i$ in Figure 2(a) or 2(b) which shows the import (or excess) demand curves for each good in the two countries, MD_i, obtained by subtracting the domestic supply from the domestic demand at each price. The uniform tariff in Figure 2(a) is equal to P_iP_i* where its greater welfare cost of $a_1c_1d_1e_1$ compared with the actual tariff situation for good 1 just equals the lesser welfare cost of $a_2c_2d_2e_2$ compared with the actual tariff situation for good 2, and conversely in Figure 2(b). Notice that this welfare-equivalent uniform tariff is closer to the actual tariff on the more-elastic good 1 than to that on good 2 in both countries, and hence is below the average NRP in the first country but above the average NRP in the second country. This result accords with the intuition that tariffs on relatively elastic goods are more trade-restrictive than tariffs on relatively inelastic goods. The only additional pieces of information required to calculate this simplest of TRIs in addition to the NRP, or PSE and CSE, are the price elasticities of domestic demand and supply or the excess demand elasticity for each good.

The proponents have gone further in showing how it is possible to generate more complex TRIs, including general equilibrium versions, that are increasingly more satisfactory in terms of their theoretical basis and internal consistency.[5]

How much difference is there in practice between the TRI and the PSE/CSE measures? In an earlier paper, Anderson and Bannister (1992) reported partial equilibrium measures of the change in trade restrictiveness of substantial changes in Mexican agricultural policy between 1985 and 1989. Over that four-year period of reform their estimate of the TRI fell by 41 per cent, whereas the conventionally estimated PSE and CSE fell only 15 and 1 per cent, respectively. The authors decomposed the TRI change into changes in the analogous or 'consistent' producer and consumer subsidy equivalents, which were -31 and -72 per cent, respectively. That is, consumer subsidies were reduced drastically and producer support was cut by less than half as much, yet Mexico's agricultural policy became substantially less restrictive of imports according to the TRI indicator. The authors estimate that the reforms brought the sector two thirds of the way towards free trade. They tested the sensitivity of their TRI measure to changes in elasticity values, incidentally, and found their results to be quite robust.

Like partial and general equilibrium modelling, the TRI is more likely to become a supplement to rather than a substitute for the NRP or PSE/CSE and ERP calculations, as its estimation may involve relatively little additional work and it still has the virtue of being a single indicator that can be described in plain words.

Indicators of the extent of nontariff trade barriers

The phasing down of bound tariffs since the first GATT round of multilateral trade negotiations (from above 40 per cent to less than 4 per cent for imports of manufactures by OECD countries over the past 55 years) has reduced dramatically their relative importance over time. Applied tariffs have fallen even more than the rates bound in GATT/WTO schedules. Non-tariff trade barriers (NTBs), on the other hand, have been slower to eradicate, and new NTBs are being added or threatened each year (Laird and Yeats 1990; Baldwin 1991; Laird 1997). Particularly difficult to measure are technical product or process standards when products are heterogeneous, because domestic-to-border price comparisons are inadequate when there are not 'like' products to compare. This is a current challenge the World Bank and others are focusing on (see, for example, Maskus and Wilson 2001).

Indicators of the extent of indirect protection via exchange rate distortions

Distortions to exchange rates also affect the domestic price of tradables relative to nontradables (Corden 1981). Drawing on a World Bank multi-country study of distortions to agricultural incentives, Krueger, Valdes and Schiff (1988) show that for their sample of 18 developing countries, overvalued exchange rates have been far more significant anti-agricultural and anti-trade instruments than tariffs, import quotas, import licensing and other direct forms of assistance or taxation of farm products combined. Even in Sub-Saharan Africa where direct taxation of agricultural exports had been huge (averaging 23 per cent in the 1960-84 period), the indirect discrimination against farming because of overvalued exchange rates was

[5] See Anderson and Neary (1994) for details, and their diskettes for spreadsheet versions that are ready to use on a personal computer.

even larger, at 29 per cent on average for the studied countries of that region. In total those taxation and foreign exchange policies meant that farmers in that poor continent received less than half the gross earnings of their exports – a huge rate of taxation by any standard.

2. Measuring the cost of protection

The cost of protection, or more generally of industry assistance/taxation, refers to the losses imposed by all policy-induced distortions affecting directly the tradables-producing sectors of the economy. Those distortionary measures could be not only trade taxes or subsidies but also production or consumption taxes or subsidies on products, on intermediate inputs, or on factors of production.[6] The cost is usually measured against free markets, including free international trade in final products and intermediate inputs (though not usually in productive factors). In the absence of distortions and if all factors are perfectly mobile between sectors, this is the optimal policy setting.[7] An alternative perspective is to measure it against the first-best policy instrument for achieving the particular 'non-economic' objective of society that the tariff is ostensibly targeting (although this is difficult if several objectives are being targeted simultaneously). An additional literature measures the benefits of liberalizing markets[8], in which case the reform usually is measured against either current policies or what those policies otherwise would be. The latter is appropriate if, for example, protection was rising over time and the measurement of its effects was calibrated for a future year. If the experiment involves bilateral or multilateral reform, any terms of trade changes associated with other countries' reforms need to be included in the calculus.

Three of the early attempts to measure the cost of protection were for sectors where rates of protection were very high by international standards: Australian manufacturing (Brigden et al. 1929), Canadian manufacturing (Young 1957), and German agriculture (Gerschenkron 1943). In critiquing the Brigden study, Corden (1957) developed what might be considered the first comprehensive methodology which, with the seminal paper by Johnson (1960), has provided the foundation for subsequent empirical analysis of the cost of protection in both partial and general equilibrium.

The cost of tariff protection consists primarily of a production component and a consumption component (in partial equilibrium the Harberger (1959) deadweight welfare cost triangles, such as *abc* and *def* in Figure 1 for a small economy). Such measures are an improvement over earlier calculations that measured just the cash value of the producer subsidy equivalent or consumer tax equivalent (the price wedge times the volume of production or consumption, e.g. *PbcP'* or *PdfP'* in Figure 1). They usually ignore the costs of lobbying for and then administering the tariff, and of 'leakages' in such forms as corruption at the customs post and smuggling. The vast majority of empirical studies also usually assume that perfect competition and constant returns to scale operate, thereby underestimating the cost of protection in so

[6] A comprehensive taxonomy is provided in Bhagwati (1971). See also Vousden (1990).

[7] However, to the extent trade in factors is complementary with rather than a substitute for trade in products, the counterfactual should be broadened to include unrestricted factor trade too. Compare, for example, Mundell (1957) with Markusen (1983); but note that the outcome when both product and factor trade are opened up is not obvious (Michaely 2002).

[8] Major efforts to examine the effects of trade liberalizations in developing countries include Bhagwati (1978), Krueger (1978), and Michaely, Papageorgiou and Choksi (1991).

far as imperfect competition and increasing returns are present. Nonetheless, this basic approach has been the workhorse of countless partial equilibrium studies of the cost of protection and, as the popularity of studies such as those sponsored by the Institute for International Economics shows, they have great appeal to the policy community. That appeal no doubt is partly because the approach is relatively easy to explain.

When import quotas or voluntary export restraints (VERs) are used as the protective instrument instead of a tariff, the costs of a given level of protection are higher. What would have been the tariff revenue (area *bdfc* in Figure 1) becomes the quota rent which, in the case of VERs, is transferred to the foreigner. In the numerous cases where large countries are imposing such quantitative trade barriers, there are also terms of trade effects to consider (as there are also with a tariff). They can lead to efficiency losses for the exporting countries that more than offset the quota rent transfer -- as found in several of the US studies of VERs surveyed by Feenstra (1992). They also lead to extra losses (a) if the quotas are volume based because that measure encourages the exporting of more-processed or higher-quality products within the product group for each quota, (b) if the quotas are allocated (rather than auctioned) but not to the lowest-cost exporting countries, (c) if the licences to fill an exporting country's quota are allocated (rather than auctioned) but not to the lowest-cost firms in that country, (d) if the quota leads to additional lobbying, in this case for an allocation of the quota, that erodes the rent transfer, and (e) if the VER encourages inefficient foreign direct investment (FDI) in the importing country in lieu of exporting the product to that country, or FDI in another (higher-cost) exporting country.[9]

3. Measuring other economic effects of protection

With the growth in computing power, the economics profession has been able to go well beyond measuring just the cost of protection. Single-commodity, single-country partial-equilibrium studies have been supplemented and often superseded by the development of multi-commodity industry or sectoral models of world markets in partial equilibrium, and economy-wide single- or multi-country computable general equilibrium (CGE) models. Agricultural modelling in the 1980s is discussed below as a good example of the former, before attention turns to CGE developments.

Partial equilibrium global modelling: the case of agricultural markets

The impetus to develop global models of agricultural markets came in the early 1980s as it became clear that agriculture was likely be included in a substantial way in the up-coming (Uruguay) round of multilateral trade negotiations – a first since the GATT began in the late 1940s (Josling, Tangermann and Warley 1996). The first such model, by Valdes and Zietz (1980), was a direct application of the Corden/Harberger/Johnson partial equilibrium methodology for a large number of agricultural products. However, each product market was considered independent of the others (zero cross-price elasticities). A model that took interdependence into account was developed by Tyers (1984) for grain and meat markets and applied initially to analyse the European Community's Common Agricultural Policy (Anderson and Tyers 1984). That model was subsequently expanded to include the

[9] On the relative inefficiency of quotas over tariffs, see Anderson (1985, 1988).

highly protected sugar and dairy sectors and became the basis for the empirical work reported in the World Bank's 1986 *World Development Report* in time for the launch of the Uruguay Round in September that year (Tyers and Anderson 1986). Meanwhile, several international agencies and the US Department of Agriculture began building similar models,[10] but they were mostly comparative static and deterministic. By contrast, the Tyers/Anderson model was dynamic and stochastic, and it also included international-to-domestic price transmission elasticities to capture the insulation effect of agricultural trade policies in addition to their protective effect.[11]

Even though these models did not distinguish internationally traded products by country of origin, as proposed by Armington (1969), they were very influential in raising public awareness during the Uruguay Round of the impact of growth of agricultural protection levels in the 1980s on farm production, consumption and trade, on the mean and variance of domestic and international food prices, and on national and global economic welfare (as measured by equivalent variations in income).

The estimated costs of protection as captured by those models was probably a reasonable economic welfare measure for advanced industrial countries, because agriculture is a small part of those economies and the distortions to non-farm tradable sectors is small relative to those for agriculture. For poorer countries, however, agriculture is a much larger share of GDP and employment, and their industrial and service sectors are often highly protected from import competition. In such cases, a cut in low levels of agricultural protection could actually worsen national economic welfare, yet such partial equilibrium models would suggest there would be an economic gain (Martin 1997). Also, multilateral agricultural reform is not undertaken in isolation but – since the Uruguay Round at least -- as part of a package of trade reforms affecting all sectors. For these reasons, partial equilibrium global models began to be superseded from the early 1990s as CGE models became more disaggregated with the growth in capacity and speed of computers and in the quality of the needed data. Initial efforts to apply CGE models to agricultural protection issues are reported in Goldin and Knudsen (1990), but the quality of the models and applications rose dramatically over the 1990s.

CGE national and global models

The first CGE models began appearing in the 1970s, and by the early 1980s they were being used routinely for policy analysis in a number of OECD countries. For example, the first model build for Australia, known as ORANI (Dixon et al. 1982), produced results for a wide range of policy issues and made a major impact on policy debate during the microeconomic reform decade of the 1980s (Powell and Snape 1993). As noted in the surveys by Shoven and Whalley (1984) and Robinson (1989), models were also beginning to be built at that time for developing countries, an early example being Dervis, de Melo and Robinson (1982). Since then many of these national models have become far more sophisticated, and in particular have added regional, occupational and household disaggregations and have become dynamic (as for example in the transforming of the Australian ORANI model into the

[10] They included the USDA's SWOPSIM model (Roningen 1986), IIASA's model (Parikh et al. 1987) and the OECD's Trade Mandate Model (Huff and Moreddu 1989).

[11] Full details of the model including the welfare calculus, and its database and protection estimates, are provided in Tyers and Anderson (1992). A survey of these models is provided in Tongeren, Meijl and Surry (2001).

MONASH model – see Dixon and Rimmer 1998). The latter feature allows forecasting though time and hence can show paths of adjustment to shocks.

Global CGE models were slower in coming, since they require so much more data than national or regional models. Early examples are Whalley (1985) and Deardorff and Stern (1986, 1990), with the latter having more country and commodity detail. The Australian Government's Industry Commission also began building a global CGE model for trade negotiating purposes (the SALTER model – see Jomini et al. 1991). A copy of that model was taken to Purdue University and, since the early 1990s, it has been improving constantly and been made publicly available as the so-called GTAP model and database (Global Trade Analysis Project – see Hertel 1997). The extraordinary efforts by Tom Hertel to train users and recruit willing helpers to revise and update the production, trade and protection data and improve the theory in the model has resulted in hundreds of people becoming users and thousands of simulation experiments being published over the decade since its creation (see www.gtap.agecon.purdue.edu/). That openness, which has been characteristic of some other CGE modelling groups too, has been a great spur to modelling innovations.

The basic global GTAP model is similar in architecture to the Australian ORANI model, but more complex versions are being developed all the time. Among the modifications that have been incorporated for particular applications are scale economies and imperfect competition (Francois 1998), dynamics through capital accumulation (Francois and McDonald 1996), and those plus foreign direct investment (Dee, Hanslow and Phamduc 2000). In addition, computational tools for practical policy analysis have been developed to enable systematic sensitivity analysis (Pearson and Arndt 2000) and decomposition of economic welfare results (Huff and Hertel 2001). Trade and related policy analysis is now possible for any of the 66 countries or country groups in Version 5 of the GTAP model and any of its 57 sectors of production (20 agricultural and processed food sectors, 22 other manufacturing sectors, and 15 services sectors). Since Armington elasticities are included, bilateral as well as total trade effects can be explored. This enables far more sophisticated analyses for bilateral, regional and multilateral trade negotiations than was possible only a few years ago.

GTAP is of course not the only such CGE model, but it is certainly the most widely used. Others were also used in the ex post analysis of the Uruguay Round (see the various chapters in Martin and Winters 1996) and are now being used for ex ante analyses of the current WTO round of trade negotiations and the numerous bilateral and regional free-trade-area proposals that have become fashionable again in recent years.

Another popular family of models arose from expanding a global macro model by adding some sectoral detail (McKibbin and Wilcoxen 1995). While having far fewer sectors and regions than GTAP, and while relying heavily on the GTAP database, the McKibbin family of models includes capital markets and is dynamic and so is able to generate paths of adjustment to simulated shocks. As in dynamic national CGE models, the latter feature has obvious appeal to policymakers concerned with the short to medium term effects of reform on their constituents.

4. Where to from here?

Notwithstanding the enormous progress that has been made in the 45 years since Corden first published his paper on calculating the cost of protection, much scope for improvement remains. Theoretical developments have been running well

ahead of empirical modelling, as the Feenstra (1995) survey and the final six chapters of Francois and Reinert (1997) make clear. Data developments and parameter estimation have been relatively slow (an international public good problem), as have efforts to specify well the policy instruments being modelled in both the base and reform scenarios. We begin with the latter, since it has been a major source of criticism of Uruguay Round modelling.[12]

Improving the specification of existing and alternative policy measures

Several mis-specifications of policy measures are clear from the ex post and especially the ex ante modelling of Uruguay Round (UR) reforms. First, UR (as with past GATT and future WTO) commitments relate to reductions in bound tariff rates, not applied rates, and bound rates can be higher (in agriculture's case often several times higher) than applied rates. Yet many modellers used applied rates in calibrating their models and then reduced them by the extent of the promised bound tariff cuts, thereby overstating the magnitude of reform – in some cases by a huge margin. The recent efforts by UNCTAD, the World Bank and others to estimate both sets of tariffs will hopefully allow modellers to solve this problem in the near future if sufficient funding is provided by those international agencies.

Second, a wide array of tariff preferences operate for various groups of developing country exporters and among members of preferential-trade areas.[13] Often in the past these have been ignored by modellers. Again this has been because such data have not been available in a form that modellers could readily use. While some efforts are being made currently to rectify that, the problem will not easily be solved because many of the poor developing countries enjoying preferential (in many cases duty-free) access to markets of rich countries are small and so do not appear separately in global CGE models but rather as part of a group of developing countries.

Third, it is in agriculture where most of the remaining gains from goods trade liberalization are to be found.[14] Reforming that sector should have been straightforward following the promised tariffication of all nontariff agricultural trade barriers following the UR, but such is not the case. The reason is that governments agreed to allow countries to set their bound tariff at excessively high levels so long as they promised at least existing levels of imports to come in at low tariffs. That triggered the use of so-called tariff rate quotas (TRQs). As the Appendix makes clear, TRQs add considerable complexity to modelling empirically even the domestic impacts of agricultural trade policies and their reform, let alone their trade effects. In short:

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[12] Criticism has come even from within the international economics profession. See, for example, Panagariya (1999).

[13] Preferences also apply to trade among WTO members relative to their trade with non-members, since most members have a general tariff rate that exceeds the most-favoured-nation bound rate that WTO members enjoy. This distinction has become unimportant with the growth in the number of nations that are WTO members, however, especially now that most non-members (with the important exceptions of Russia and Saudi Arabia) are least developed countries enjoying other forms of preferential access. WTO members now account for more than 95 per cent of world trade.

[14] According to GTAP modelling results reported in Anderson (2002a), fully two-thirds of the gains from eliminating all merchandise import barriers globally in 2005, after full implementation of Uruguay Round commitments, would come from agriculture.

- in the presence of TRQs the national welfare cost of agricultural protection can be considerably greater than what a given domestic-to-border price wedge would imply if a tariff-only regime prevailed;
- modelling an x per cent cut in the bound tariff as if it is a cut of that size in the applied rate can overstate the price and quantity effects of reform not only because the bound rate exceeds the applied rate but also because the applied rate may be above the prohibitive tariff in the presence of the quota, such that the actual effects could range (in a kinked non-linear fashion) from anything between zero to 100 per cent of the modelled effects;
- the modelled effects of a tariff cut on national welfare, by contrast, could understate or overstate the gains from further reform, depending on how the quota is being administered before and after the next reform;
- an expansion of the market access (quota) commitment need not ease this measurement problem, for it is always possible for the quota administrator to allocate those quotas so as to ensure under-fill such that no more or even less imports in total flow in; and
- modelling the effects of the TRQ regime, and changes to it, on bilateral trade flows and thereby on the welfare of this economy's trading partners also is more complex than modelling their effects under a tariff-only regime, with in-quota and out-of-quota tariff preferences for some trading partners adding further complications for modellers.

Fourth, an additional complication for modelling agriculture is that many countries impose quarantine restrictions and even bans on imports of farm products. Hence even if the bound rates and TRQs had been correctly modelled, the results may still overstate what would actually happen following tariff cuts and TRQ expansions if those quarantine restrictions begin to bite. It will be a long time before we have a comprehensive usable data base showing the extent of protection afforded by such nontariff barriers, even though it may be even larger than that due to the bound tariff on numerous farm products. This problem will escalate as and when food safety process standards (eg for GMOs) become more widespread, since the concept of 'like product' will come under challenge. Similar protective effects result from technical barriers to trade on non-farm products. The Uruguay Round's Sanitary and Phytosanitary Agreement and Technical Barriers to Trade Agreement have only gone a small way towards disciplining the abuse of these forms of trade protection.

Fifth, safeguards may be applied under certain circumstances such as import surges. That may well be how the US and/or EU respond when the present voluntary export restraints on textile and clothing trade are removed under the UR Agreement on Textiles and Clothing at the end of 2005 (or a few years later for China and possibly other WTO accedants such as Vietnam). That possibility should be kept in mind when modelling manufacturing liberalizations.

And sixth, most models have ignored or at best captured only very crudely the distortions to services trade and investment flows. Those barriers are considerable, but are difficult to measure and represent in standard CGE models (see Hoekman 1996; Findlay and Warren 2000; Dee et al. 2000). Yet when those distortions are not included, there is the same problem with interpreting the welfare effects of goods trade reform generated by a CGE model as there is from a partial equilibrium model of a subset of markets in the presence of distortions in other markets of that economy. That is, if services distortions greatly exceed goods protection then decreasing the latter could worsen national economic welfare even though a CGE model which

specifies zero distortions for services markets will suggest a welfare gain from a goods protection cut. The only solution to this problem is to continue to build on the pioneering work reported in Findlay and Warren (2000) on measuring the extent of distortions to markets for services and that of Dee and others in incorporating those measures into CGE models.

Effects of trade reform in the presence of other domestic divergences

In addition to services markets being distorted, many other domestic markets are typically distorted by government policies or labour union/management agreements. Ideally those distortions should all be specified in each model, but that is a formidable task. In the meantime, in describing model outputs there should always be the caveat that the results are exaggerated to the extent that there are domestic distortions that would inhibit actual market adjustments to reduced trade barriers.

As well, there may be divergences (to use Corden's (1974) term) in the form of environmental or social concerns that the government has not optimally addressed. That too can lead to smaller actual social welfare gains than our economic models might suggest, or even to losses, from trade liberalization (eg if there is a sufficiently large and uncorrected negative environmental externality associated with producing more exportables). Proponents of the idea that agriculture is 'multifunctional', and for that reason deserves government support, try to make that claim (Anderson 1998). Distinguishing between genuine widespread environmental or social concerns, and the claims of self-serving vested interests, is not always easy in practice.

Imperfect competition and scale economies

A more-widespread incorporation in CGE models of imperfect competition and scale economies (following the example set by modellers of the European Union's Single Market in the 1990s) would accelerate if we had better empirical estimates of the mark-ups firms impose and the extent of economies of scale in different industries. These modifications are especially crucial for the services sector, as is the incorporation of foreign direct investment flows. Hence the more these models are going to be used to analyse services policy reforms, the more important are those inclusions. Also needed are better data on services trade and better specifications of services policy measures, particularly if the GTAP database (which many other non-GTAP global modellers also depend on) is to be disaggregated beyond the 15 services sectors in the current Version 5.

Dynamics of trade liberalization

Including capital accumulation and thereby making global CGE models dynamic is a tall order (see, e.g., Grossman and Helpman 1991), but it would open up opportunities to address additional issues. One is the intergenerational transfers that could result from tariff reforms affecting asset values. Those effects would depend on any terms of trade changes and hence are affected by whether a small economy's liberalization is unilateral or part of a multilateral reform package. Another issue such a model could handle better than present ones is selective temporary protection (of which anti-dumping is perhaps the most notorious). A third issue, and one that is important for poorer countries, is the greater scope there would be to assess ways of accommodating the revenue consequences of tariff changes, including via debt

financing (Keuschnigg and Kohler 1997). And forth, estimates of the costs of adjustment over time could be more-easily incorporated.

But perhaps the most important contribution that dynamic models could make is to show how much greater are the gains from trade liberalization than is apparent from comparative static models,[15] and how little are the adjustments needed because of trade reform relative to those due to the normal pace of structural changes that accompany economic growth.

Effects on factor markets and especially wages and employment

The evident concern about the possibility that trade reform could have adverse impacts on wages and/or employment for lower-skilled workers in developed countries has attracted considerable interest of analysts in general (see Greenaway and Nelson 2001) but less interest from empirical CGE modellers than one might expect even though in principle CGE models are well served to provide insights. The problem in practice is that the factor market assumptions used by many modellers are often rather simplistic (and horrify labour economists): full employment before and after the policy shock, a perfectly inelastic supply curve for labour, few if any skill differentials or sector-specific skills, costless adjustment to shocks, and often no minimum wages or any other factor market distortions. Parading factor market results would require exposing those assumptions (and those assumed for land and capital markets). Clearly these factor market issues should be being dealt with for the sake of getting better trade and welfare results anyway, so if greater demands for such modelling results lead to more-realistic specifications of factor and especially labour markets, that will be a doubly good thing. And in any case it is needed for responding also to the next point.

Effects on household and regional income disparities and poverty alleviation

The Seattle debacle in late 1999 and the protests at numerous global economic leaders' meetings since then make clear that there is a strong demand for empirical modellers to say something also about the impact of shocks such as trade policy reform on the distribution of incomes across households and regions within each country, and in particular on the incidence of poverty, especially in poorer countries. That requires going beyond calculating just factorial income distributional effects. It requires including utility functions for several instead of just a single household. Inputs into that specification could be household survey data for urban and rural areas, from which it may be possible to estimate the shares of different (say) quintiles or deciles of households' incomes from different productive factors and from government transfers net of taxes, and the shares of their expenditure on different products.[16]

Domestic policy responses to trade reform

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[15] Developing countries that have opened up relatively rapidly have seen their incomes converge toward OECD levels faster than others. See, for example, the evidence surveyed in Dollar (1992), Edwards (1993, 1998), Greenaway et al. (1998), Harrison (1996), USITC (1997), and Winters (2000a).

[16] Recent examples of modelling exercises along these lines are Friedman (2000) and Hertel et al. (2000). Will Martin is currently managing a large World Bank research project along similar lines, focusing on the income distributional and poverty effects of China implementing its WTO accession commitments.

Having identified the gainers and any losers from a trade policy change, one could draw on our understanding of the political economy of economic policy formation to anticipate what additional policy changes might be forthcoming in response to the trade liberalization. Those responses could then also be modelled.

At the same time, the likely effects of other potential domestic policy changes that might be needed to meet society's economic, social and environmental objectives could be presented alongside results for the trade reform, to show how any adverse effects from that reform might be most-efficiently dealt with. This step may be very important if the results of the ex ante trade reform simulation are seen as politically unpalatable, because otherwise the government may choose simply to abandon its trade reform plan.

5. Has better measurement led to more trade policy reform?

Cynics will say that we have known about the gains from trade for more than two centuries and yet trade restrictions remain, while advocates for empirical research will point to and claim some credit for the remarkable extent of trade liberalization that has occurred globally over the past half-century. The relevant question is: *how much* credit can be claimed by the empiricists? There is no way of answering this precisely, but a few points are worth making.

First, revealing the fact that Australia and New Zealand had the most protected industrial sectors among the OECD countries until the 1980s – and noting that they were the slowest-growing of the OECD economies in the post-war period -- was helpful in bringing down their protection levels during the past two decades. The same is true of the comparison between the less-protected and faster-growing developing countries of East Asia post-1960 and the more-protected and slower-growing ones elsewhere.

Second, revealing the extent of effective protection to agriculture relative to manufacturing in key OECD countries, and of the industrial sector relative to primary sectors in many developing countries, helped to alter the domestic political economy forces in both sets of countries. The large increase in the farmer/manufacturer assistance gap in OECD countries between the end of the GATT's Tokyo Round and the start of its Uruguay Round of multilateral trade negotiations also helped to ensure agricultural protectionism was placed and remained high on the agenda of the UR.

Third, revealing the vast across-industry differences within sectors of protection rates, which were much bigger than the differences in nominal rates, helped governments to resist domestic pressures in their country to maintain or raise protection for the most assisted groups.

And fourth, empirical estimates of the consumer and net welfare costs of protection have made it easier for advocates of reform to gain headlines than when relying on only abstract arguments about the gains from trade, while estimates of the cost of protection to non-protected industries and to exporters abroad have helped build coalitions for trade liberalization.

If economists are to be any more influential, they need to understand better why governments intervene in markets, for as Stigler (1975, p. xi) says, 'Until we understand *why* our society adopts its policies, we will be poorly equipped to give

useful advice on how to change those policies'.[17] The availability of effective rate of assistance estimates, and now of CGE models (especially if they are embellished in ways mentioned in the previous section), make it easier to address questions such as why some industries or sectors are assisted or taxed more than others and why and how the pattern of industry assistance changes in the course of economic development or in response to major shocks.

6. Conclusion

Clearly, while empirical trade modellers within the international economics profession have come a long way since the late 1950s, plenty of exciting challenges remain for empirical modellers interested in having an impact on the real world of trade policy reform. A key to further progress, though, is an expansion in investment in a key international public good required by modellers, namely, data that can be readily used in CGE models to capture the intricacies of the policy measures countries have adopted. The highest priorities would be agricultural and services protection data, since they remain the two key sectors where protectionism is still substantial and where the protective effects of the measures used are still difficult to model.

[17] Corden understood that: he wrote an early paper on the logic of tariff protection (Corden 1962), and then developed the concept of a conservative social welfare function (Corden 1974). He also went to some trouble to explain the trade liberalizations of both Australia and developing countries (Corden 1995). A not-unimportant contributing factor was the freeing of exchange rates, which allowed the required exchange rate depreciation to more-easily accompany tariff cuts (Little, Cooper, Corden and Rajapatirana 1993).

Appendix:

Effects of a tariff rate quota regime on the domestic price, trade and welfare of an agricultural-importing economy

Under the Uruguay Round Agreement on Agriculture (URAA) some WTO members have imposed a tariff rate quota (TRQ) regime on certain farm products. That involves setting a bound tariff (typically more than the tariff actually applied) on out-of-quota sales and a lower in-quota tariff for a specified volume of imports. The initial impact of imposing such a TRQ regime is depicted in Figure 3, where this economy's import demand curve for the product is line D. For simplicity, the economy is assumed to be a sufficiently small player in the global market for this product that its imports do not affect the international price, and its in-quota tariff is assumed to be zero, in which case the quota volume, Q, is imported at the international price P*.

If this was an import quota regime (now illegal under WTO), the domestic price would be P_q and the national economic welfare loss from restricting imports to Q, instead of allowing the free-trade volume Q*, would be area *abc* plus a percentage of the potential quota rent which is area *bcde.* What that latter percentage is depends on how the import licenses are administered: it is zero only if all licenses go to the lowest-cost domestic firms and those firms are allowed to import from the lowest-cost suppliers abroad. (By contrast, if say only Q_2 of the Q units were allocated to domestic firms, the national welfare loss would be greater by area *bcrj*.)

It is possible to achieve the same outcome under a TRQ regime as under a traditional import quota. In terms of Figure 3, all that is required is to set the out-of-quota applied tariff (and therefore the bound rate) at $P_q - P^*$ per unit or more.

Only if the out-of-quota applied tariff is set at a value of less than $P_q - P^*$ per unit would there be any out-of-quota imports under a TRQ regime. If the applied rate was set at the specific rate of t_1 per unit, for example, the domestic price would be $P^* + t_1$ and an additional $Q_1 - Q$ units would be imported. Compared with a prohibitive out-of-quota tariff, this would generate less potential quota rent (lower by area *cdhg*) but would cause domestic consumer surplus net of domestic producer surplus to be higher by area *cdhf*, and tariff revenue of area *fgbn* would be collected by the government. Hence net economic welfare would be greater by area *fcbn* as compared with no out-of-quota imports, again assuming all licenses go to lowest-cost domestic firms and those firms are free to source imports from the lowest-cost suppliers abroad.

If some licenses are made valid only for imports from high-cost foreign suppliers (as applies for some products under the European Union's agreement with ACP countries, for example), this importing economy's welfare would be further reduced. It could be reduced by even more than the maximum quota rent for volume Q (area *bcde*). Suppose, for example, the licenses are restricted to imports from a set of countries whose export supply curve measured at cif prices is line S. Even if the out-of-quota applied tariff was more than t_2, those foreign suppliers could afford to export only Q_2 units to this economy, causing the domestic price to be $P^* + t_2$ rather than P_q because of the quota being underfilled by $Q - Q_2$ units. In this case there would be no quota rents, and the net economic welfare cost of imposing such a TRQ regime would be much larger than described in the previous two paragraphs. Specifically, compared with free trade, the welfare cost of this regime would be area

aemk, regardless of whether the licenses are allocated to domestic or foreign firms, whereas the cost of the regimes described in paragraphs one and two are potentially just areas *abc* and *anf*, respectively. To that needs to be added the cost to government of administering the license allocation system and the lobbying costs of firms seeking a share of those licenses.

Effects of a new commitment to lower the bound out-of-quota tariff

Suppose at the end of the URAA implementation period/the current Doha Round negotiations (which coincide on 1 January 2005) this economy commits itself to lower its bound tariff on this product. If a tariff-only regime was in place, the impacts of that reform would be somewhere between zero and 100 per cent of the impacts of an equally large cut in the applied tariff, depending on the extent to which the bound rate exceeds that applied rate. (The proportion starts to rise above zero only after the bound rate is brought down to the applied rate.) In the presence of a TRQ regime, however, the impacts are even smaller if the out-of-quota tariff is still prohibitive. Indeed even if licenses were held by domestic firms and imports were sourced from the most efficient suppliers, there would be no impact at all from that reform commitment if the cut in the bound rate was insufficient to bring the applied tariff down to less than $P_q - P^*$ in Figure 3. The maximum impacts are possible only if the out-of-quota applied tariff is not prohibitive *and* the bound rate is not above the applied rate.

If there were (a) restrictions on sourcing from lowest-cost suppliers, and/or (b) only some of the quota (say Q_2) was allocated to domestic firms, the welfare gains from bringing the applied tariff down to a non-prohibitive level would be substantially greater than without those features of quota administration. For example, if the tariff was reduced from more than t_2 to just t_1, there would be an additional gain of (a) area *bemkc* if the requirement on domestic firms to source from high-cost imports along curve S was removed, and (b) area *gcrw* if only Q_2 of the quota licenses were in the hands of domestic firms.

Effects of a new commitment to expand the quota

Even more than a commitment to lower the bound tariff, a commitment to expand the quota could have anything between zero and more than 100 per cent of the standard impact described in textbooks. If the quota had not been administered frictionlessly in the past and had not been fully allocated to domestic firms, and there were changes in favour of domestic importers as part of the new commitment, the economy's actual welfare gain could exceed the maximum gain normally estimated for a quota increase.

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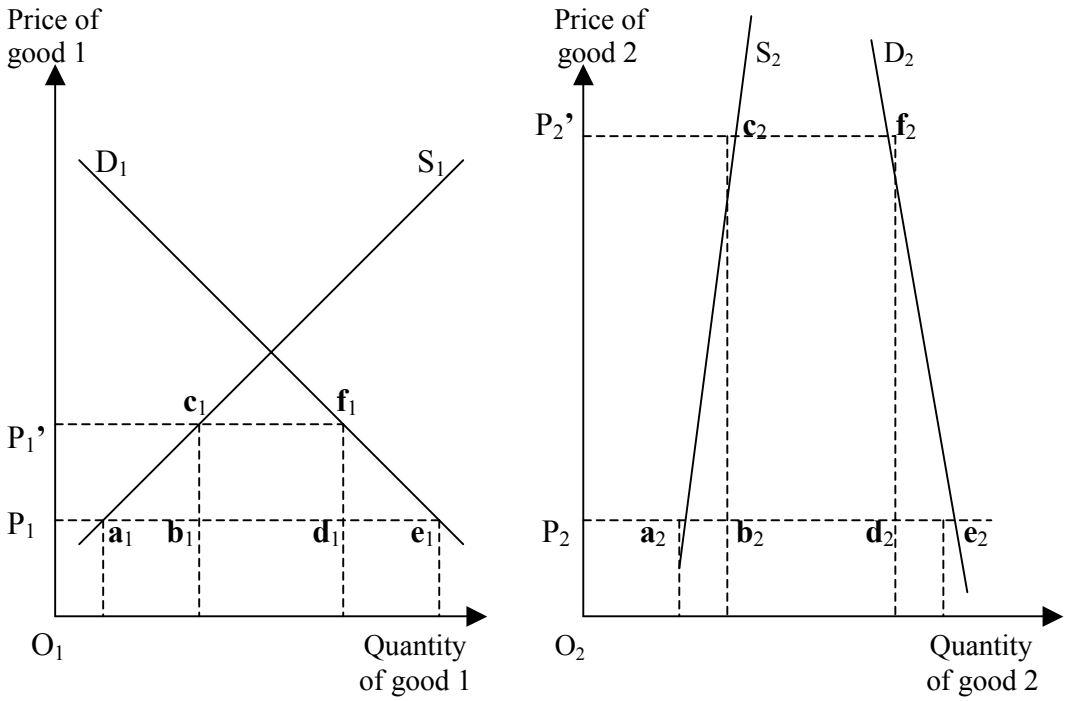
Figure 1: Domestic demand and supply for two imported goods

(a) First country: negative correlation between tariff rates and import demand elasticities



(b) Second country: positive correlation between tariff rates and import demand elasticities

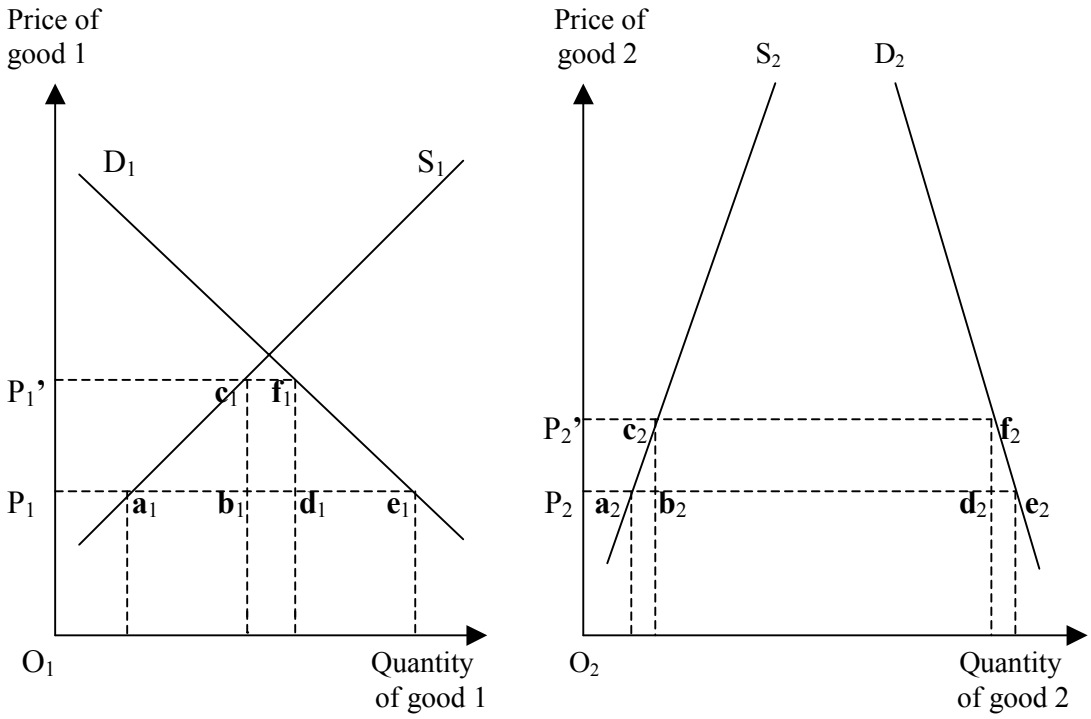
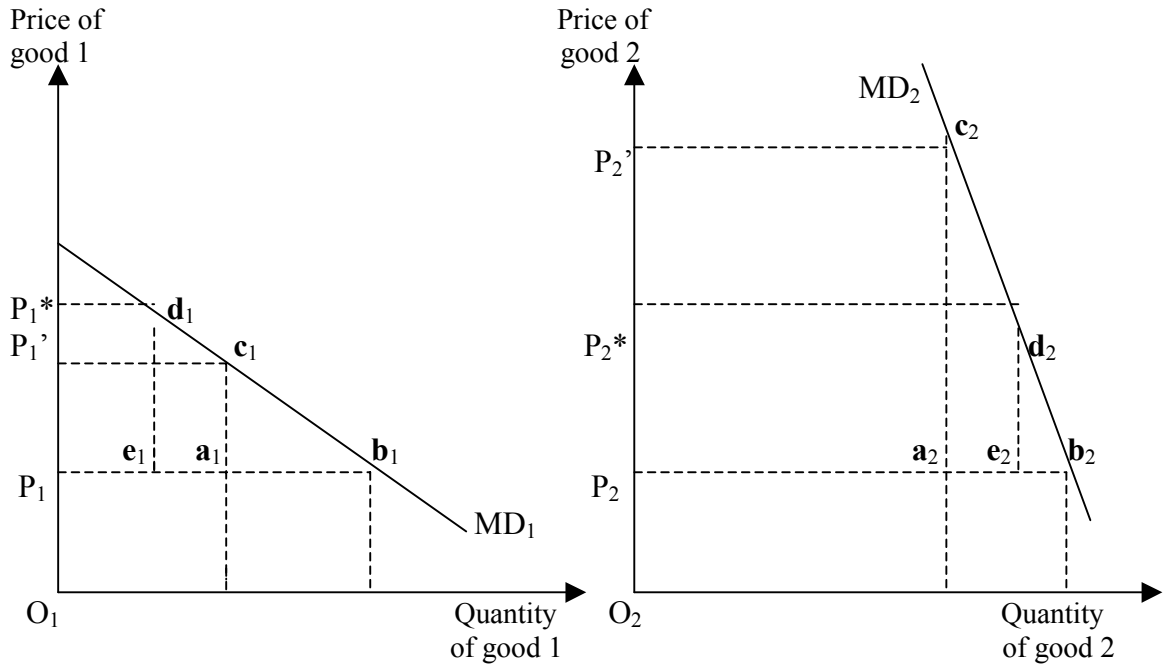


Figure 2: Import demand for two imported goods

(a) First country: negative correlation between tariff rates and import demand elasticities



(b) Second country: positive correlation between tariff rates and import demand elasticities

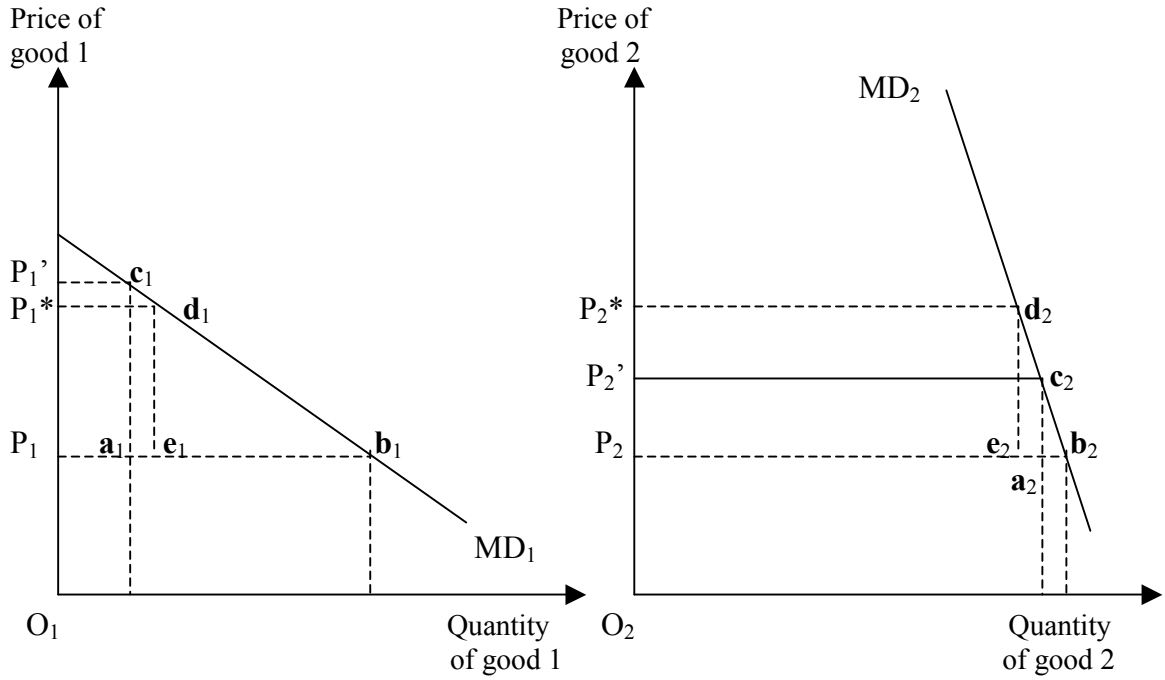
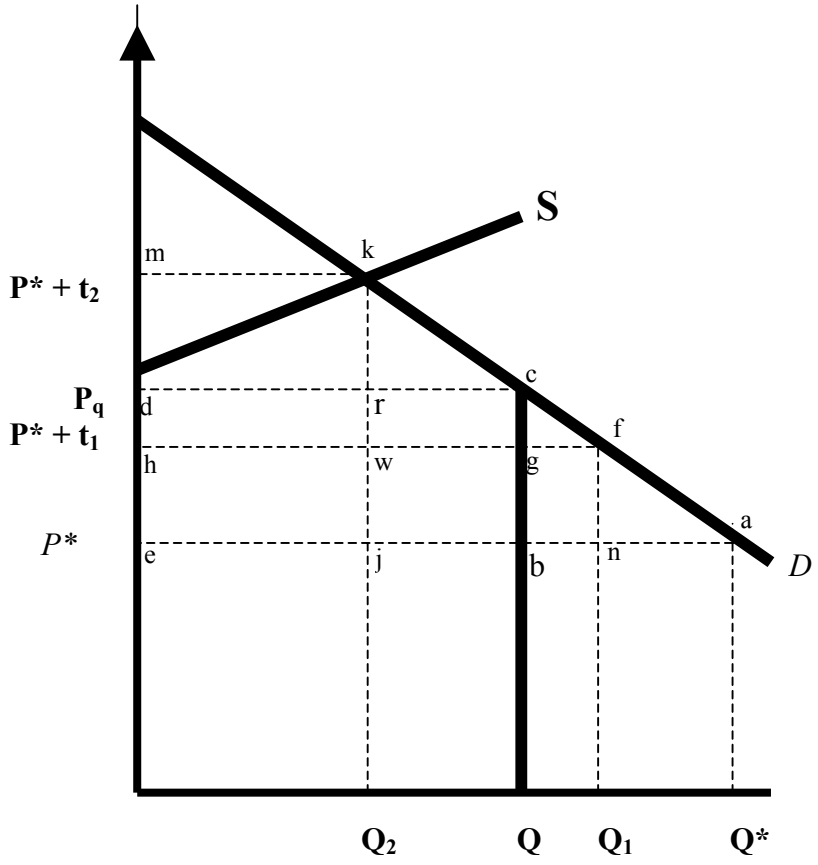


Figure 3: Domestic price, trade and welfare effects of an agricultural tariff rate quota regime on a small economy



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